FOUNDATION INVESTIGATION

PROPOSED TENRIKYO HAWAII CENTER

NUUANU, OAHU, HAWAII

TMK: 1-8-03

Parcels 1, 14, 16, 17, 18, 19, and 20

for

WILLIAM L. PEREIRA ASSOCIATES

July 30, 1973

W.O. 206

ERNEST K. HIRATA & ASSOCIATES, INC.

ERNEST K. HIRATA & ASSOCIATES, INC.
Soils and Foundation Engineering
1157 South King Street • Honolulu, Hawaii 96814 • Phone 531-5733

July 30, 1973
W.O. 206

William L. Pereira Associates
10th Floor
915 Fort Street
Honolulu, Hawaii 96813

Attention: Mr. Phillip Mowrey

Gentlemen:

Our report, "Foundation Investigation, Proposed Tenrikyo Hawaii Center, Nuuanu, Oahu, Hawaii, TMK: 1-8-03: Parcels 1, 14, 16, 17, 18, 19, and 20", dated July 30, 1973, our Work Order 206 is enclosed. This is the report requested by you and planned in cooperation with personnel of Dimitrios Bratakos & Associates, Inc., Structural Engineers.

The exploratory borings indicate that the surface soils consist of medium stiff to stiff reddish brown silty clay. Underlying the silty clay were strata of sandy and clayey silts. Boring 4 encountered fill consisting of dark brown to black silty clay. The fill was found to be loose in the upper two feet then grading medium stiff.

Although some loose fill was encountered in boring 4, the onsite soils were found to be stiff below two feet. The site was found to be feasible for the proposed development. Conventional shallow foundations may be used for the support of the foundation loads.

We appreciate this opportunity to be of service. Should you have any questions, please feel free to call on us.

Very truly yours,

Ernest K. Hirata & Associates, Inc.

Ernest K. Hirata

Ernest K. Hirata

EKH:ph

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INTRODUCTION

This report presents the results of our foundation investigation performed on the subject property. The purpose of this investigation was to determine the nature of the soils underlying the site, to ascertain their engineering properties, and to provide recommendations for foundations and floor slabs.

This investigation included drilling four exploratory borings, obtaining representative soil samples, laboratory testing and analysis, and the preparation of this report. The exploratory boring locations are shown on the enclosed Plate 1. Also attached is an Appendix which describes the laboratory testing procedures.

STRUCTURAL CONSIDERATIONS

Information concerning the proposed development was furnished by personnel of Dimitrios Bratakos & Associates, Inc., Structural Engineers.

The proposed structure will be a one story day care center and judo hall of wood frame construction. There will be a large central room with plan dimensions of approximately 54 by 72 feet surrounded by smaller classrooms. Foundation loads will be supported by both columns and bearing walls. The maximum column load will be on the order of 25 kips. The bearing wall loads will be relatively light.

SITE CONDITIONS

The property is located at the northeast intersection of Robinson Lane and Nuuanu Avenue. Two wood frame residences were observed on the site. The site for the proposed day care center is located in the northeast corner of the property where a heavy growth of brush and trees are located. The total relief on the site is approximately 20 feet with drainage flowing from a northerly to southerly direction.

FIELD EXPLORATION

The site was explored on July 18 and 19, 1973 by drilling four exploratory test borings with a truck-mounted rotary drilling machine. The borings varied in depth from 13 to 15 feet. The boring locations are shown on Plate 1, and the soils encountered are logged on Plates A1 through A4.

The soils were continuously logged by our field engineer and classified by visual examination in accordance with the Unified Soil Classification System.

Undisturbed samples of soils were obtained at frequent intervals by driving a 3 inch O.D. steel sampler with a 140 pound hammer. The required blow count for each six inches of penetration are shown on the "Boring Logs".

SOIL CONDITIONS

The exploratory borings indicate that the surface soils consist of medium stiff to stiff reddish brown silty clay. Underlying the silty clay were strata of sandy and clayey silts. Boring 4 encountered fill consisting of dark brown to black silty clay. The fill was found to be loose in the upper two feet then grading medium stiff.

Groundwater was not encountered to the maximum depths drilled.

RECOMMENDATIONS

General

Although some loose fill was encountered in boring 4, the onsite soils were found to be stiff below two feet. The site was found to be feasible for the proposed development. Conventional shallow foundations may be used for the support of the foundation loads.

Foundations

Conventional spread footings may be used to support the structure provided they are founded on the stiff silty clay. Both wall and column footings may be designed for a bearing value of 4000 pounds per square foot, and should be a minimum of 12 inches in width and embedded a minimum of 24 inches below finished adjacent grade.

Lateral Design

The bearing value indicated above are for the total of dead and frequently applied live loads, and may be increased by one-third for short duration loading which includes the effect of wind or seismic forces. Resistance to lateral loading may be provided by friction acting at the base of foundations and by passive earth pressure. An allowable coefficient of friction of 0.4 may be used with the dead load forces. Passive earth pressure may be computed as an equivalent fluid having a density of 300 pounds per cubic foot. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third.

For active earth pressure considerations, an equivalent fluid pressure of 40 pounds per square foot per foot of depth may be used.

Foundation Settlement

Settlement of the foundation system is expected to be negligible for the light foundation loads.

Expansive Soils

Swell tests were performed to determine the expansiveness of the onsite surface soils. The results of the swell tests are presented below.

Boring No.	Depth	Condition	Surcharge (PSF)	% Swell
B1	3'	Undisturbed	700	3.2
B1	6'	Undisturbed	90	2.1
B2	0' - 2'	Remolded	90	6.2

Results of the swell tests indicate that the surface soils are low to moderately expansive. Floor slabs should be reinforced with a minimum of 6 x 6 - 10 x 10 welded wire fabric. In addition, a six inch layer of crushed rock should be placed under all slab on grades. Prior to the concrete pour, the subgrade should be thoroughly saturated in order to minimize the expansiveness of the soil.

Site Grading

1. All vegetation and deleterious material such as rubbish shall be disposed of offsite.

2. After the ground surface to receive fill has been cleared, it shall be scarified, disced or bladed until it is uniform and free from ruts or other uneven features which may prevent uniform compaction. The scarified ground surface shall then be brought to optimum moisture, and compacted to a minimum of 90 percent relative compaction.

3. Material used in the fills shall be evenly spread, watered, and compacted in thin lifts not to exceed six inches in thickness to obtain a uniform dense layer.

4. Each layer shall be compacted to 90 percent of the maximum laboratory density.

Inspection

It is recommended that all footings be inspected by a qualified foundation engineer prior to placing concrete or steel. Any fill which is placed should be inspected, tested, and certified.

Limitations

The boring logs indicate the approximate subsurface soil conditions encountered only at those locations where the borings were made, and may not represent conditions at other locations.

During construction, should subsurface conditions differ from those encountered in the borings, we should be advised immediately in order to review and to revise our recommendations.

Our professional services were performed, findings obtained, and recommendations prepared in accordance with generally accepted engineering practices. This warranty is in lieu of all other warranties expressed or implied.

Respectfully submitted,

Ernest K. Hirata & Associates, Inc.

Ernest K. Hirata

Ernest K. Hirata P.E. 2732

Enc:

Site Plan	Plate 1
Appendix of Laboratory Testing	
Boring Logs	Plates A1 through A4
Consolidation Test	Plates B1 and B2
Maximum Density Curve	Plate C

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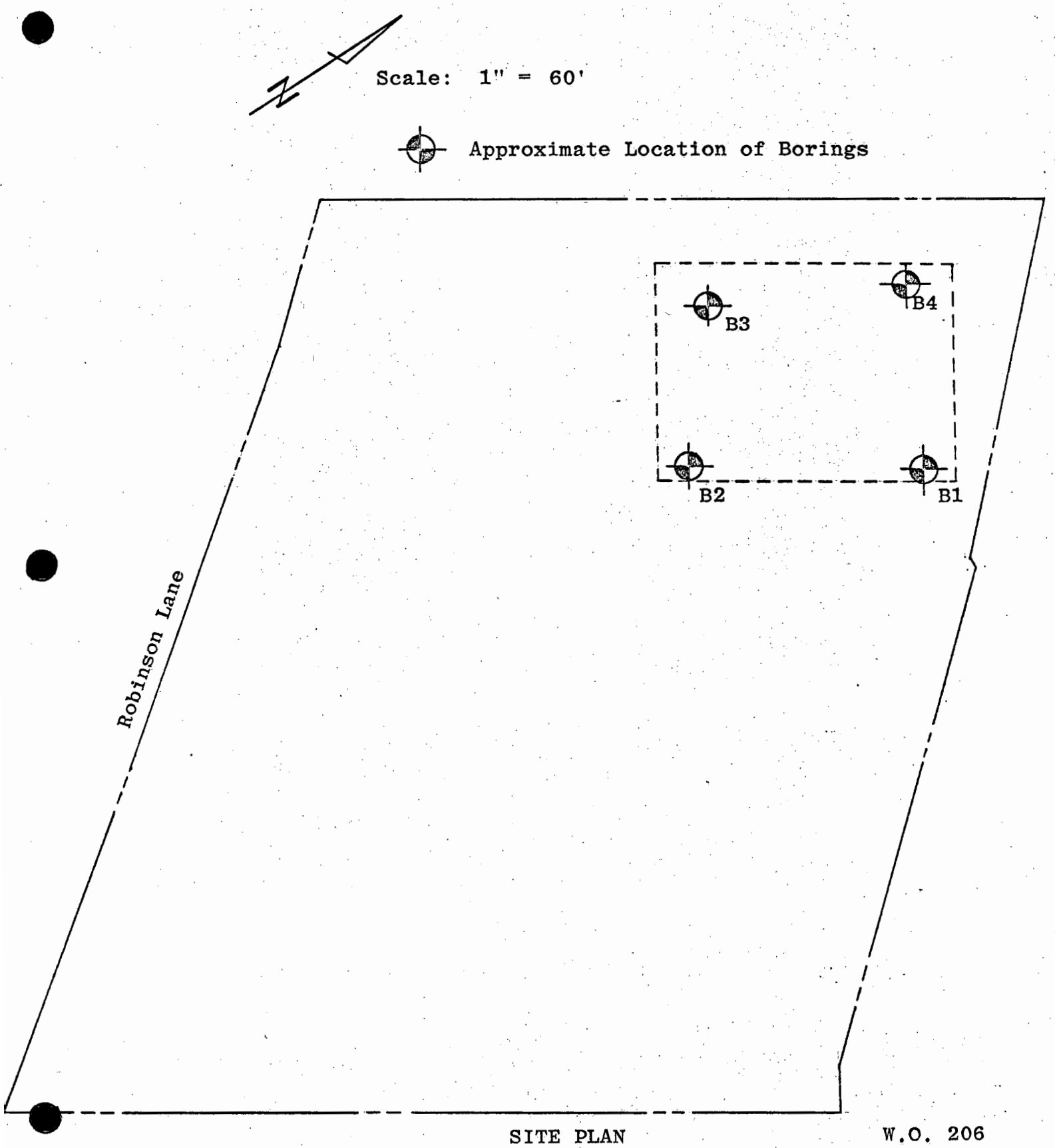


SITE PLAN

Nuuanu Avenue

W.O. 206

Plate 1

APPENDIX OF LABORATORY TESTING

Classification

The field classification is verified in the laboratory, also in accordance with the Unified Soil Classification System. Laboratory classification is determined by both visual examination and Atterburg Limit Tests according to ASTM D423 and D424. The final classification is shown on the Boring Logs.

Moisture-Density

The field moisture content and dry unit weight are determined for each of the undisturbed soil samples. The information is useful in providing a gross picture of the soil consistency between borings and any local variations. The dry unit weight is determined in pounds per cubic foot while the moisture content is determined as a percentage of the dry unit weight. These samples are obtained from a 3" O.D. split tube sampler.

Consolidation

Settlement predictions of the soil's behavior under load are made on the basis of the consolidation tests. Loads are applied in several increments in a geometric progression, and the resulting deformations are recorded at selected time intervals. Porous stones are placed in contact with the top and bottom of each specimen having an inside diameter of 2.40 inches and a height of 1 inch to permit addition and

release of pore fluid. Results of undisturbed and remolded samples are plotted on the Consolidation Test Report.

Compaction Tests

Compaction tests were performed on bag samples to determine the optimum moisture content at which each type of proposed fill material compacts to 100% density. The tests were performed according to the Modified AASHO T-180.

Swell Tests

Swell tests were performed to determine the expansiveness of the onsite surface soils. The tests were performed on undisturbed ring and remolded samples taking a one inch high specimen under different surcharge loads.

Shear Tests

Shear tests are performed in the Direct Shear Machine which is of the strain control type. The rate of deformation is approximately 0.03 inches per minute. Each sample is sheared under varying confining loads in order to determine the Coulomb shear strength parameters, cohesion and angle of internal friction. Eighty percent of the ultimate value is taken to determine the shear strength parameters.

ERNEST K. HIRATA & ASSOC.

BORING LOG

BORING NO. B1 DRIVING WT. 140 lb. DATE OF DRILLING 7-18-73

SURFACE ELEV. 185.5 ± DROP 30 in. W.O. 206

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0									Silty CLAY (ML) - Reddish brown, slightly moist, stiff to very stiff.
	x		30 62 31/2"	97.0	28.2	95.1			
5	x		20 28	82.0	31.8		62°	0.83 KSF	
			47						Sandy SILT (ML) - Mottled brown, slightly moist, clayey with gravels, hard.
10	x		71/5"	99.2	24.3				
	x		69/3"						
15									End boring at 14 feet.
20									
25									
30									

Plate A1

ERNEST K. HIRATA & ASSOC.

BORING LOG

BORING NO. B2 DRIVING WT. 140 lb. DATE OF DRILLING 7-19-73

SURFACE ELEV. 183.0 ± DROP 30 in. W.O. 206

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/ 6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0	x		19 29 35	96.8	27.1	94.9	54°	2.76 KSF	Silty CLAY (ML) - Reddish brown, slightly moist, stiff.
5	x		29 68	94.3	28.8	92.5			
	x		34 75/4"	98.9	27.4				Sandy SILT (ML) - Mottled brown, slightly moist, hard with gravels and cobbles.
10									
	x		30/0" No Penetration						End boring at 13 feet.
15									
20									
25									
30									

Plate A2

ERNEST K. HIRATA & ASSOC.

BORING LOG

BORING NO. B3 DRIVING WT. 140 lb. DATE OF DRILLING 7-19-73

SURFACE ELEV. 181.5 ± DROP 30 in. W.O. 206

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/ 6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0	x		6 9	67.4	42.1				Silty CLAY (ML) - Dark brown, moist, medium stiff, with cinders.
5			24						Sandy SILT (ML) - Reddish brown, slightly moist, stiff with cinders.
	x		13 15 32	86.6	32.0				Silty CLAY (CL) - Light brown, slightly moist, stiff.
10	x		32 80	93.8	26.2				Sandy SILT (ML) - Mottled brown, slightly moist, hard with cobbles and gravels.
15	x		26 44 60/5.5"	88.2	24.7				End boring at 15 feet.
20									
25									
30									Plate A3

ERNEST K. HIRATA & ASSOC.

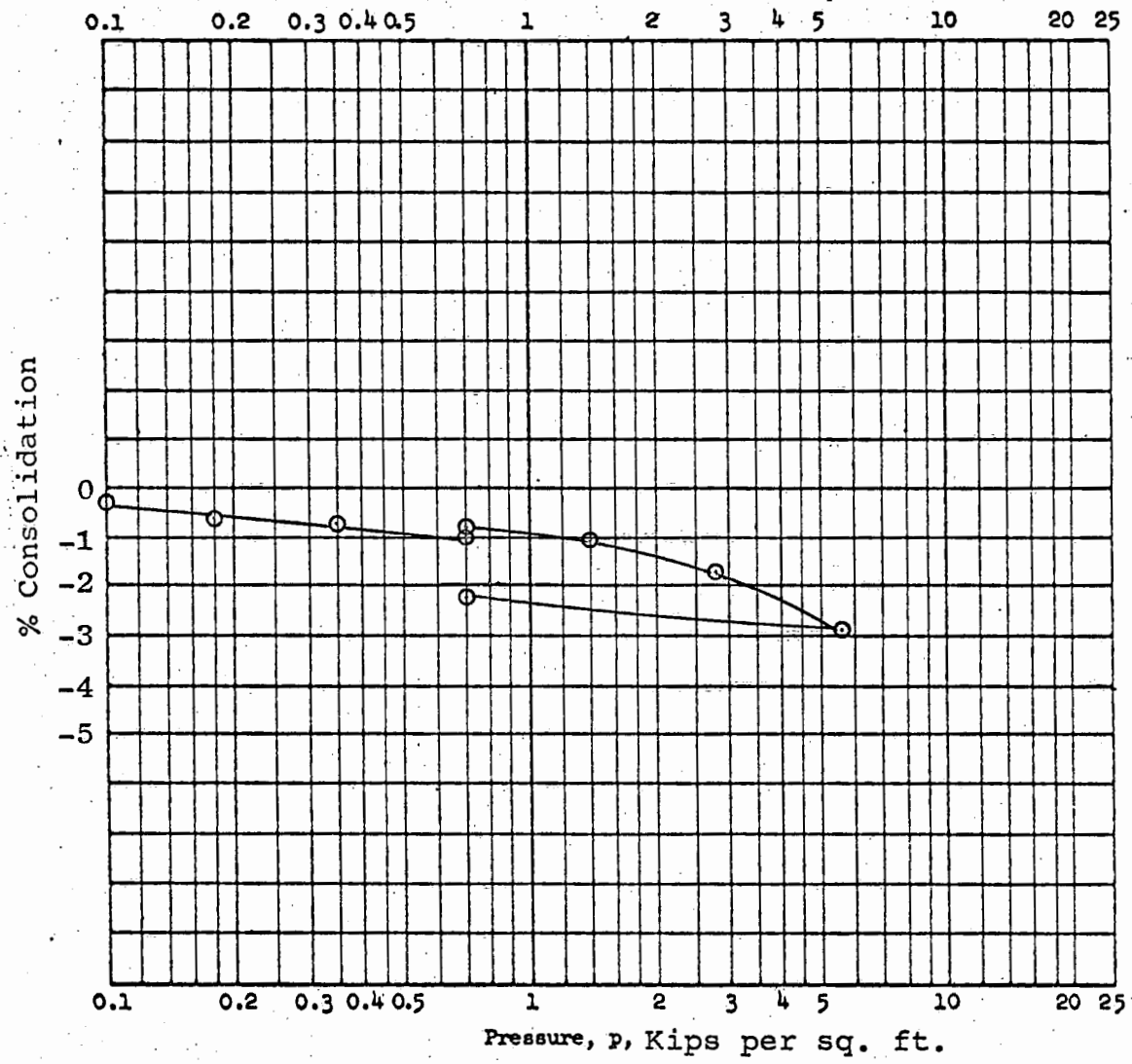
BORING LOG

BORING NO. B4 DRIVING WT. 140 lb. DATE OF DRILLING 7-19-73

SURFACE ELEV. 181.5 ± DROP 30 in. W.O. 206

DEPTH FEET	CORE	BAG	PENE. RESIST. BLOWS/ 6 in.	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS ø	DIRECT SHEAR STRENGTH PARAMETERS C	CLASSIFICATION (% Sand, % Silt, % Clay)
0	x		16 28 40	81.4	29.0				FILL - Silty Clay, dark brown to black, moist, loose to medium dense with sand.
5	x		61/1.5"		No Recovery				Clayey SILT (MH) -,Dark brown, slightly moist, stiff.
10	x		76/2.5"		No Recovery				
15	x		14 23 26	86.4	28.5				Clayey SILT (MH) - Mottled brown, moist, stiff.
20									End boring at 15 feet.
25									
30									

Plate A4



Type of Specimen: Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	31.8 %	w_f	47.6 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	82.0 lb/ft^3		
Classification ML		k_{20} at e_o =	× 10$^-$ cm/sec		
LL	G_s	Project Tenrikyo Hawaii Center			
PL	D_{10}	William L. Pereira Associates			
Remark Water added at 700 PSF		Area W.O. 206			
		Boring No. B1	Sample No.		
		Depth El 6'	Date 7-24-73		
		CONSOLIDATION TEST REPORT			

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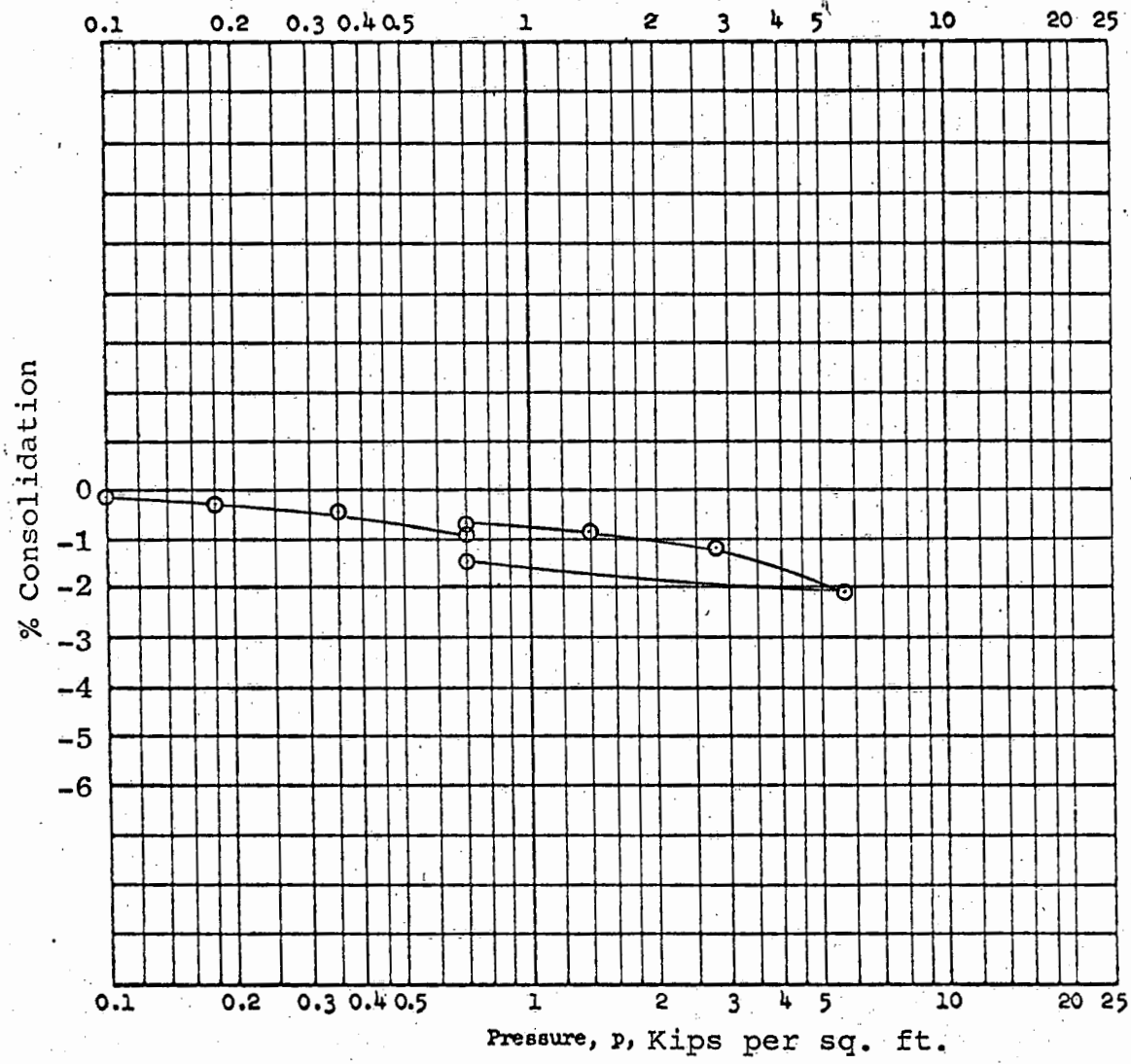
Plate B1



Type of Specimen: Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, w_o	28.5 %	w_f	34.3 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	86.4 lb/ft^3		
Classification MH		k_{20} at e_o =	x 10$^-$ cm/sec		
LL	G_s	Project Tenrikyo Hawaii Center			
PL	D_{10}	William L. Pereira Associates			
Remarks Water added at 700 PSF		Area W.O. 206			
		Boring No. B4	Sample No.		
		Depth El 13.5'	Date 7-23-73		
		CONSOLIDATION TEST REPORT			

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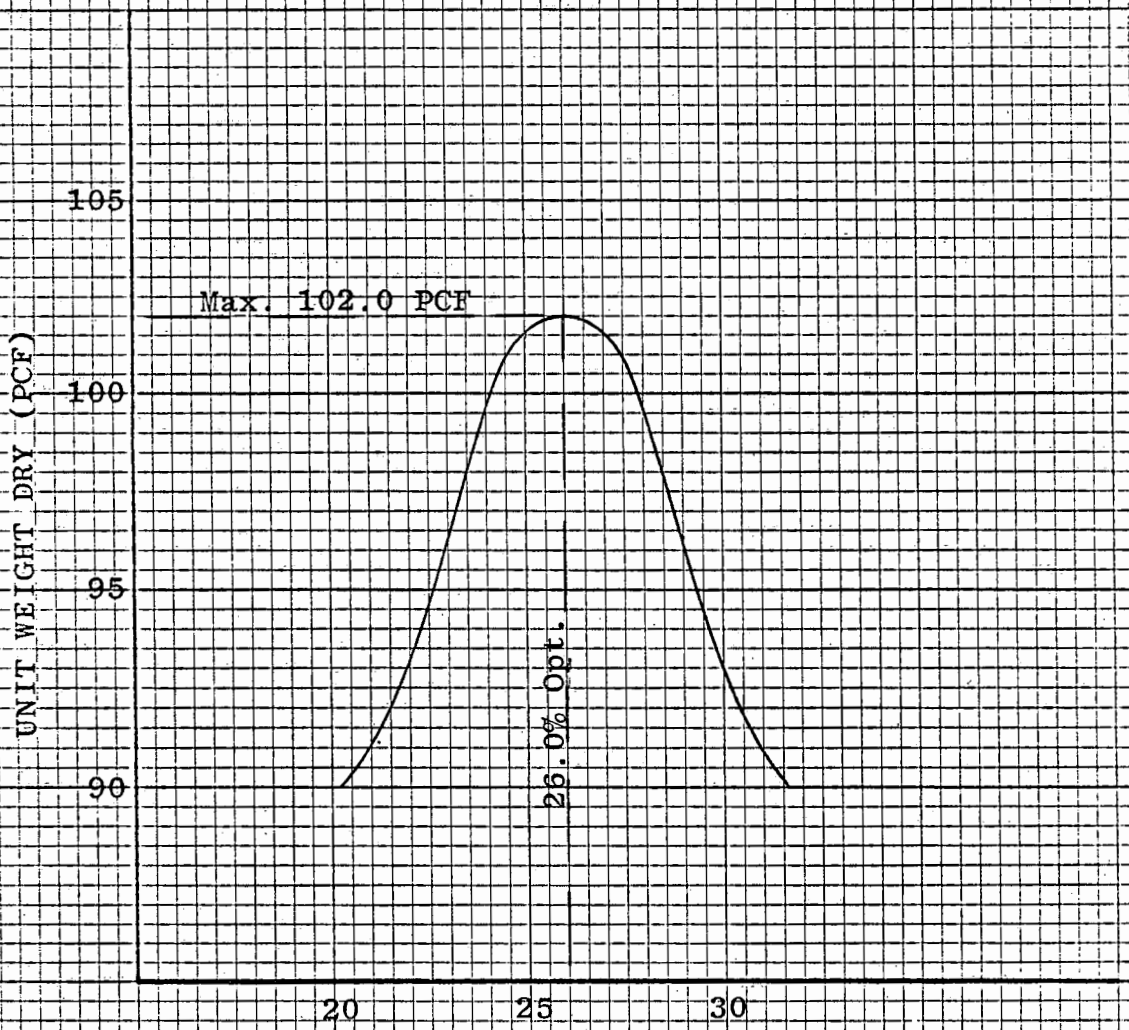
Plate B2

MAXIMUM DENSITY CURVE



Boring: B2 Surface

Depth: 0 - 2'

Classification: Reddish Brown Silty CLAY

W.O. 206

Plate C